System Operating Limit Definition and Exceedance Clarification

The NERC-defined term System Operating Limit (SOL) is used extensively in the NERC Reliability Standards; however, there is much confusion with – and many widely varied interpretations and applications of – the SOL term. This whitepaper describes the standard drafting team's (SDT) intent with regard to the SOL concept, and brings clarity and consistency to the notion of establishing SOLs, exceeding SOLs, and implementing Operating Plans to mitigate SOL exceedances.

System Operating Limit Definition Clarification:
The approved definition of SOL as defined in the NERC Glossary of Terms is:

> *The value (such as MW, MVar, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. SOLs are based upon certain operating criteria. These include, but are not limited to:*
>
> - *Facility Ratings (Applicable pre- and post- Contingency equipment or Facility ratings)*
> - *Transient Stability Ratings (Applicable pre- and/or post-Contingency Stability Limits)*
> - *Voltage Stability Ratings (Applicable pre- and/or post- Contingency Voltage Stability)*
> - *System Voltage Limits (Applicable pre- and post-Contingency Voltage Limits)*

The proposed revised definition of SOL is:

> *All Facility Ratings, System Voltage Limits, and stability limits, applicable to specified System configurations, used in Bulk Electric System operations for monitoring and assessing pre- and post-Contingency operating states.*

The concept of SOL determination is not complete without looking at the associated NERC FAC standards approved FAC-008-3, proposed FAC-011-4, and proposed FAC-014-3 and related TOP and IRO standards (proposed TOP-001-6 and IRO-008-3):

1. The purpose of approved FAC-008-3, which is applicable to both Generation and Transmission Owners, is to ensure that Facility Ratings used in the reliable planning and operation of the BES are determined based on technically sound principles. The standard requires both Generation Owners and Transmission Owners to have a documented Facility Ratings methodology and to establish Facility Ratings consistent with that methodology that respects the most limiting applicable Equipment Rating of the individual equipment that comprises that Facility. The scope of the Ratings addressed are required to include, as a minimum, both Normal and Emergency (short-

term) Ratings (approved FAC-008-3, Requirement R3, part 3.4.2). A 24-hour continuous rating is an example of a Normal Rating; however, rating practices vary from entity to entity and may include ratings that vary with ambient temperature. Typical Emergency (short-term) Emergency Ratings have a finite duration of less than 24 hours (e.g., 4 hours, 2 hours, 1 hour, 30 minutes, or 15 minutes).

2. The purpose of proposed FAC-011-4, which is applicable to Reliability Coordinators, is to ensure that SOLs used in the reliable operation of the BES are determined based on an established methodology or methodologies. Proposed FAC-011-4 contains requirements that addresses each type of SOL: Facility Ratings, System Voltage Limits, and stability limits:

   a. Requirement R2 requires that the Reliability Coordinator's SOL methodology include the method for Transmission Operators to determine which owner-provided Facility Ratings (provided via FAC-008-3) are to be used in operations such that the Transmission Operator and its Reliability Coordinator use common Facility Ratings.

   b. Requirement R3 requires that the Reliability Coordinator's SOL methodology include the method for Transmission Operators to determine the System Voltage Limits to be used in operations. The subparts of requirement R3 contain several associated requirements.

   c. Requirement R4 requires that the Reliability Coordinator's SOL methodology include the method for determining the stability limits to be used in operations. The subparts of requirement R4 contain several associated requirements.

3. Proposed FAC-011-4 requirement R6 contains the minimum framework for SOL exceedance determination to be used in the TOP and IRO standards. Specifically, requirement R6 requires the Reliability Coordinator's SOL methodology to include, at a minimum, the following Bulk Electric System performance framework:

   a. Part 6.1: System performance for no Contingencies demonstrates the following:

      Part 6.1.1. Steady state flow through Facilities are within Normal Ratings; however, Emergency Ratings may be used when System adjustments to return the flow within its Normal Rating could be executed and completed within the specified time duration of those Emergency Ratings.

      Part 6.1.2. Steady state voltages are within normal System Voltage Limits; however, emergency System Voltage Limits may be used when System adjustments to return the voltage within its normal System Voltage Limits could be executed and completed within the specified time duration of those emergency System Voltage Limits.

      Part 6.1.3. Predetermined stability limits are not exceeded.

      Part 6.1.4. Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur.[1]

[1] Stability evaluations and assessments of instability, Cascading, and uncontrolled separation can be performed using real-time stability assessments, predetermined stability limits or other offline analysis techniques.

a. Part 6.2: System performance for the single Contingencies listed in Part 5.1 demonstrates the following:

   i. Part 6.2.1: Steady state post-Contingency flow through Facilities within applicable Emergency Ratings. Steady state post-Contingency flow through a Facility must not be above the Facility's highest Emergency Rating.

   ii. Part 6.2.2: Steady state post-Contingency voltages are within emergency System Voltage Limits.

   iii. Part 6.2.3: The stability performance criteria defined in the Reliability Coordinator's SOL methodology are met[1].

   iv. Part 6.2.4. Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur[1]

b. Part 6.3: System performance for applicable Contingencies identified in Part 5.2 demonstrates that: instability, Cascading, or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur.

c. Part 6.4: In determining the System's response to any Contingency identified in Requirement R5, planned manual load shedding is acceptable only after all other available System adjustments have been made.

4. Proposed FAC-014-3, Requirement R2 requires that Transmission Operators establish SOLs for its portion of the Reliability Coordinator Area in accordance with its Reliability Coordinator's SOL methodology.
5. Proposed TOP-001-6, Requirement R25 and IRO-008-3, Requirement R7 require Transmission Operators and Reliability Coordinators, respectively, to use the Reliability Coordinator's SOL methodology when performing Real-time Assessments, Real-time monitoring, and Operational Planning Analyses to determine SOL exceedances. The SOL exceedance framework is included in the SOL methodology via the proposed FAC-011-4 requirement R6 (above).
6. The requirements within proposed FAC-011-4, when combined with the BES Exception Process which is designed to bring impactful facilities into the BES, ensure that all Facilities that can adversely impact BES reliability are either designated as part of the BES or otherwise incorporated into operations studies.

Some have interpreted the language in previous versions of FAC-011 to imply that the objective is to perform prior studies to determine a specific MW flow value (SOL) that ensures operation within the criteria specified in FAC-011, with the assumption being that if the system is operated within this pre-determined SOL value, then all of the pre- and post-Contingency requirements described in FAC-011 will be met. The SDT believes this approach may not capture the complete intent of the SOL concept within FAC-011, which is both:

1. To know the Facility Ratings, voltage limits, transient stability criteria, and voltage Stability criteria, and

2. To ensure that they are all observed in assessments of both the pre- and post-Contingency state when performing Operational Planning Analyses (OPA), Real-time Assessments (RTA), and Real-time monitoring.

It is important to understand the intent behind the language "the pre- and post-contingency state." The pre-Contingency state is synonymous with the actual or initial state of the system. For example, for Real-time monitoring and Real-time Assessments, the pre-Contingency state refers to actual flows and voltages on the system as indicated by SCADA systems or state estimators at the time the assessment or monitoring occurs. For OPAs, the pre-Contingency state refers to the base case flows and voltages in the system models that are observed prior to simulating any Contingencies.

The post-Contingency state is a calculation or simulation of the expected state of the system if a Contingency were to occur. The post-Contingency state can be determined, or calculated, by analysis processes or tools such as Real-time Contingency Analysis (RTCA). Such tools calculate the flows and voltages on the system that are expected to occur based on simulated Contingencies. It is important to understand that when this document refers to the post-Contingency state or post-Contingency flows or voltages, it is referring to calculations based on analysis processes or tools. It is not referring to the state of the system after a Contingency event actually occurs. When a Contingency event actually occurs in Real-time operations, the system is now in a new state. The former post-Contingency state is now the new pre-Contingency state, and new RTAs then need to be executed to determine the new post-Contingency state based on these new conditions.

A primary focus of System Operators is to ensure reliable operations with regard to Facility Ratings, System Voltage Limits, and transient and voltage stability criteria for the pre- and post-Contingency state. In Real-time operations, any of these types of limits can be the most restrictive limit at any point in time in the pre- or post-Contingency state. For example, if an area or Facility of the BES is at no risk of encroaching upon stability or voltage limitations in the pre- or post-Contingency state, and the most restrictive limitations in that area are pre- or post-Contingency exceedance of thermal Facility Ratings, then the thermal Facility Ratings in that area are the most limiting SOLs. Conversely, if an area is not at risk of instability and no Facilities are approaching their thermal Facility Ratings, but the area is prone to pre- or post-Contingency low voltage conditions, then the System Voltage Limits in that area are the most limiting SOLs.

It is important to distinguish operating practices and strategies from the SOL itself. As stated earlier, a primary focus of System Operators is to ensure reliable operations with regard to Facility Ratings, System Voltage Limits, and transient and voltage stability criteria for the pre- and post-Contingency state. How an entity accomplishes this objective can vary depending on the planning strategies, operating practices, and mechanisms employed by that entity. For example, one Transmission Operator (TOP) may utilize line outage distribution factors or other similar calculations as a mechanism to ensure SOLs are not exceeded, while another may utilize advanced network applications to achieve the same reliability objective. To illustrate, a TOP may restrict flow over a major interface to a pre-determined value as a means by which to prevent a Contingency from causing a Facility to exceed its Emergency Rating. In this scenario, the restriction of flow on this interface can be considered as the Operating Plan to prevent exceeding a Facility

Rating. Similarly, a TOP might restrict flow on a Facility to ensure that voltages at a bus remain within System Voltage Limits. In this scenario the flow restriction can be considered as the Operating Plan employed to prevent exceeding a System Voltage Limit.

In order to ensure reliable operations, the following SOL performance must be maintained:

1. **Facility Ratings:**
   In the pre- and post-Contingency state, operate within Facility capability by utilizing Normal and Emergency (short-term) Ratings, as applicable, within their associated time parameters.

2. **System Voltage Limits:**
   In the pre-Contingency and post-Contingency state, operate within normal System Voltage Limits and emergency System Voltage Limits, as applicable, within their associated time parameters.

3. **Stability Limits:**
   Stability limits are typically established to address stability phenomena in the transient or the steady-state timeframes. Stability limits are unique in that they typically are established to prevent a Contingency or a specific set of Contingencies from resulting in the particular type of instability identified in studies. Proposed FAC-011-4 requirement R4, part 4.1 requires the RC's SOL methodology to include and specify stability performance criteria for steady-state voltage stability, transient voltage response, angular stability, and System damping. Part 4.2 requires stability limits to be established to meet these prescribed stability performance criteria. For example, a study might indicate that a three-phase fault at a particular location results in exceeding the transient damping criteria threshold. A transient stability limit would be established to prevent a fault at that location from the unacceptable damping.

   Transient Stability Limits:
   Transmission Operators establish transient Stability limits to prevent intra-area instability, inter-area instability, or tripping of Facilities due to out-of-step conditions. Transient Stability limits are typically defined as the maximum power transfer or loading level that ensures critical transient reliability criteria are met. Calculated flows must be maintained within appropriate pre- and/or post-Contingency limits.

   Voltage Stability Limits:
   Transmission Operators typically stress Transmission Paths/Interfaces or load areas to the reasonably expected maximum transfer conditions or area load levels to determine whether steady state voltage Stability limits exist. Voltage Stability limits are typically defined as the maximum power transfer or load level that ensures voltage Stability criteria are met. Calculated flows must be maintained within appropriate pre- and/or post-Contingency limits.

System Operating Limit Exceedance Clarification:

The combination of requirements contained within the proposed FAC and the proposed and approved TOP and IRO standards, as well as the use of defined terms contained within those standards such as OPA, RTA, and Operating Plans when executed properly result in maintaining reliable BES performance.

Specifically,

1. FAC standards require clear determination of Facility Ratings (approved FAC-008-3) and describe a performance framework for the pre- and post-Contingency state (proposed FAC-011-4 requirement R6) for SOL exceedance determinations.
2. TOP-001-6, Requirement R13 requires that each Transmission Operator perform a Real-time Assessment at least once every 30 minutes.
3. TOP-001-6, Requirement R25 requires that each Transmission Operator shall use the applicable Reliability Coordinator's SOL methodology when determining SOL exceedances for Real-time Assessments, Real-time monitoring, and Operational Planning Analysis.
4. TOP-002-4, Requirement R2 requires that each Transmission Operator have an Operating Plan to address potential SOL exceedances identified as a result of its Operational Planning Analysis.
5. TOP-001-6, Requirement R14 requires the Transmission Operator to initiate Operating Plan(s) to mitigate SOL exceedances.
6. IRO-008-3, Requirement R7 requires that each Reliability Coordinator shall use its SOL methodology when determining SOL exceedances for Real-time Assessments, Real-time monitoring, and Operational Planning Analysis.

Facility Rating Exceedance

Facility Ratings include Normal Ratings and one or more Emergency Ratings. While Normal Ratings represent loading values that the facility can support or withstand through the daily demand cycles without loss of equipment life, Emergency Ratings allow for higher facility loading that can occur for a finite period of time and assumes acceptable loss of equipment life or other acceptable physical or safety limitations. Acceptable Facility Rating exceedance is a function of the available limit set and the magnitude of pre- or post-Contingency flows in relation to those limits as observed in Real-time monitoring or Real-time Assessments. The System Operator's goal with respect to Facility Rating exceedances is to take action as necessary, making use of both Normal Ratings and Emergency Ratings per the associated Operating Plans, to prevent equipment damage, to avoid public safety risks, and to mitigate other potential reliability impacts. Waiting to implement Operating Plans until after the time period associated with next highest Emergency Rating has been exceeded would not meet this goal. Figure 1 illustrates an SOL Performance Summary for Facility Ratings.

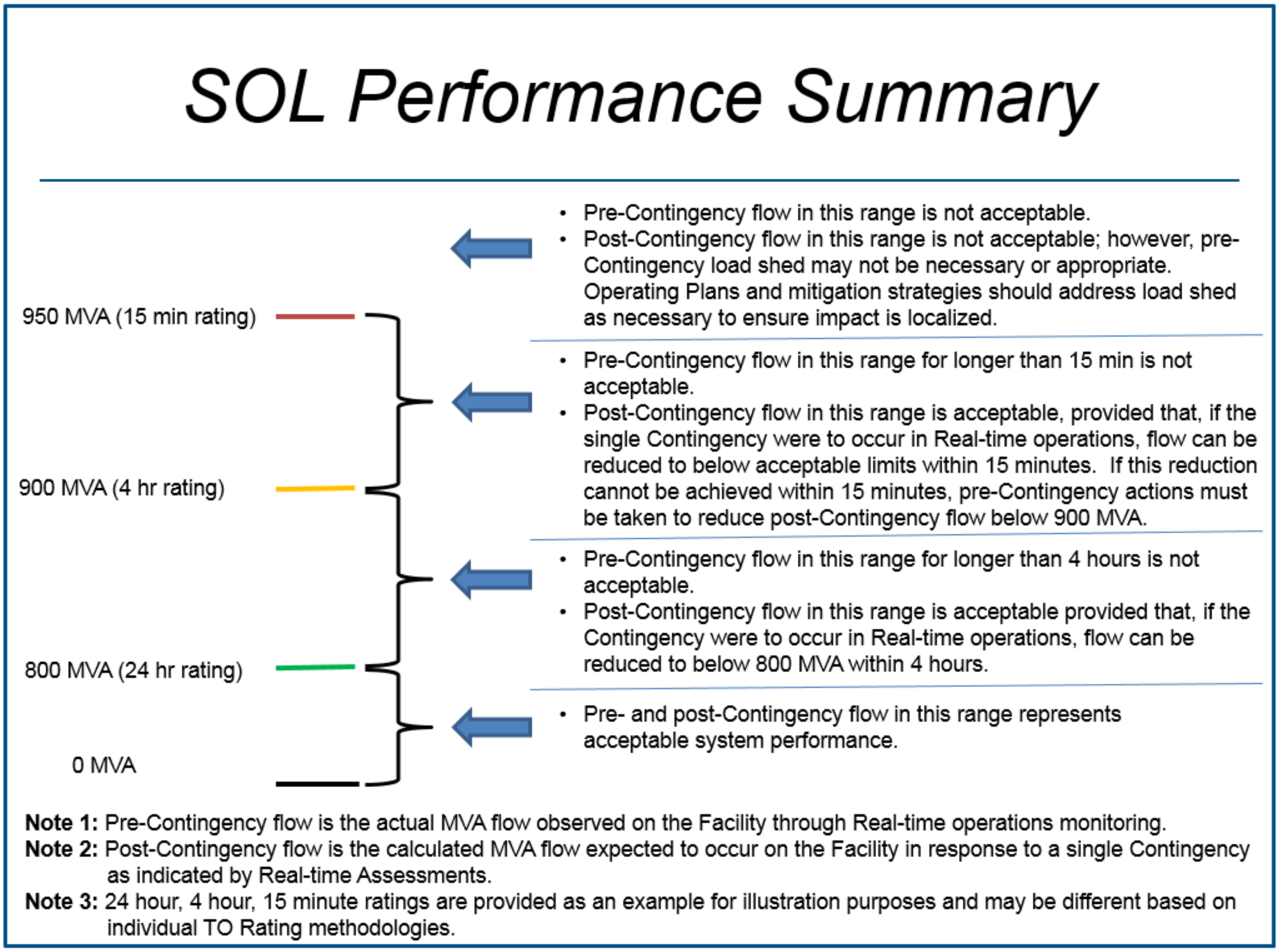

Figure 1. Facility Rating System Operating Limit Performance Summary

The following example scenarios describe appropriate operator action with respect to Figure 1:

1. **Example 1 Scenario** - System loads are increasing and actual flow on the line exceeds 800 MVA as shown in Figure 2. The System Operator is expected to take actions as necessary in accordance with the Operating Plan to ensure that flow is reduced to below 800 MVA within 4 hours. The Operating Plan may not require immediate operator action if loads are expected to decrease within the next hour as an example. In this case, the Operating Plan might require the TOP to monitor the flow and include other mitigating actions if the loading does not decrease as expected so that flow can be reduced to within the 800 MVA limit prior to the expiration of the 4 hours (assuming that Real-time Contingency Analysis (RTCA) does not indicate that a Contingency would result in this Facility exceeding the 950 MVA rating.) It is important to state that waiting until 3:45 min into a 4-hour rating to take actions might use up equipment life. So, while it is acceptable operation for system performance, it may not be acceptable operation for the equipment owner to make use of the full 4-hour rating if actions were available to be taken.

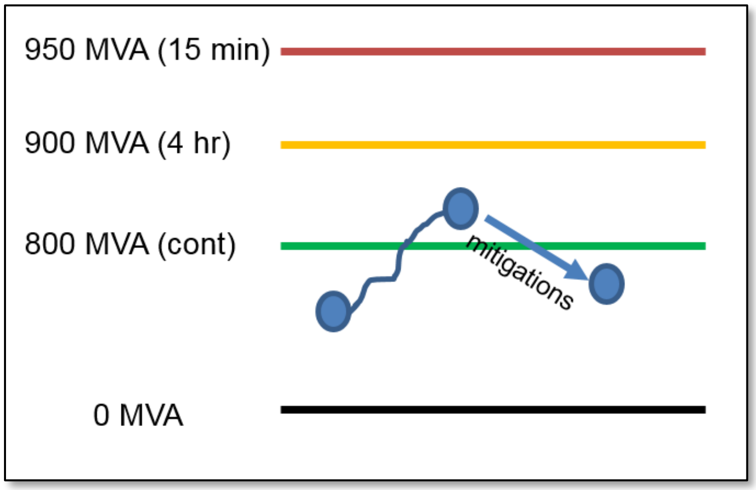

Figure 2. Example 1 Scenario – Pre-Contingency State

2. **<u>Example 2 Scenario</u>** - Flow on the line is 500 MVA. RTCA indicates that a single Contingency elsewhere in the system would cause flow on the line to immediately jump to 975 MVA. This condition represents unacceptable system performance for the post-Contingency state. Accordingly, the System Operator is expected to take action (pre-Contingency mitigation action) to reduce the post-Contingency flow such that RTCA no longer indicates that flow on this line would jump to a value higher than 950 MVA if the Contingency were to occur. Reference Figure 3 below for a pictorial of this scenario. In cases where post-Contingency flow exceeds the highest available Facility Rating as shown in Figure 1, post-Contingency Operating Plans are not adequate, and TOPs are expected to take pre-Contingency action to relieve the condition (including redispatch, reconfiguration, and making adjustments to the uses of the transmission system); however, the operating condition may not warrant shedding load pre-Contingency to relieve the condition. Pre-Contingency Load shed is generally utilized as a last resort in conditions where the next Contingency could result in Cascading or widespread instability. An entity's Operating Plan is expected to define when it is appropriate to shed Load pre-Contingency versus post-Contingency while ensuring the BES remains N-1 stable.

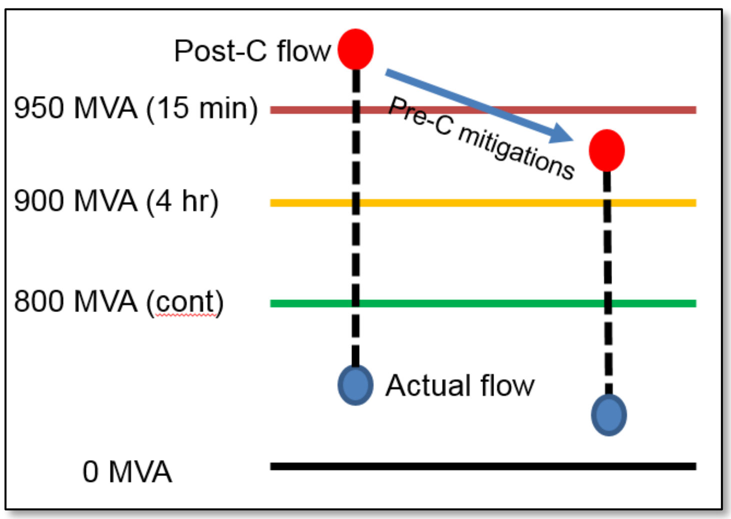

Figure 3. Example 2 Scenario – Unacceptable Post-Contingency State

3. **<u>Example 3 Scenario</u>** - Flow on the line is 500 MVA. RTCA indicates that if a single Contingency elsewhere in the system were to occur, flow on this line would immediately jump to 925 MVA. If the Contingency were to occur, the System Operator would have 15 minutes to reduce flow on this line to an acceptable level. The acceptable level could be either 900 MVA or 800 MVA depending on how the line is rated based on the Transmission Owner's Facility Ratings methodology. If this information is not known, the System Operator should assume that flow would need to be reduced to below 800 MVA. If the Contingency actually occurs and the flow is not reduced to an acceptable level within 15 minutes, facilities could be damaged, or worse, the line could sag creating a public safety hazard. For this scenario it is important for reliability that any post-Contingency Operating

Plans (i.e., any Operating Plans that are employed after an actual Contingency event occurs) can be fully implemented to reduce flows within 800MVA within 15 minutes to avoid equipment damage or unsafe line sagging. If it is determined that a post-Contingency Operating Plan is viable, then it is acceptable to remain in this state and to wait to take mitigating action if the Contingency were to actually occur. Operators would then increase monitoring of this Facility as part of the Operating Plan and to be prepared to take action if the Contingency event actually occurs. If it is determined that the post-Contingency Operating Plan is unable to reduce flow to acceptable levels within 15 minutes, then the System Operator must take pre-Contingency actions to reduce post-Contingency flows to below 900 MVA (i.e., take pre-Contingency action that result in RTCA indicating that a Contingency would result in flows below 900 MVA). Reference Figure 4 below for a pictorial of this scenario.

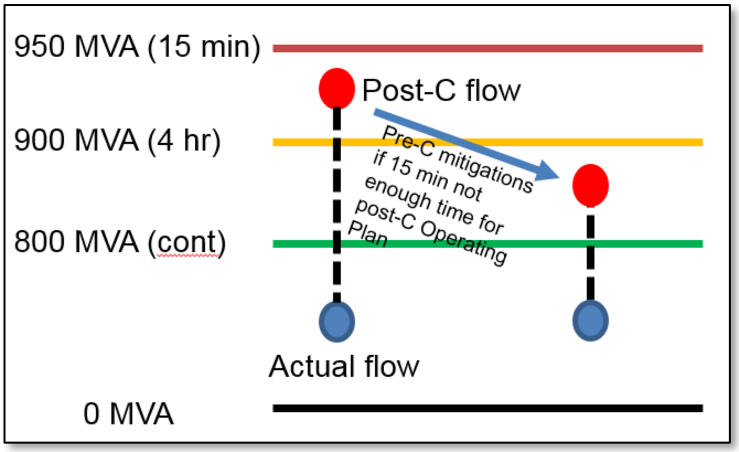

Figure 4. Example 3 Scenario – Post-Contingency State May Require pre-Contingency Mitigation

4. **<u>Example 4 Scenario</u>** - Similar to scenario 3, flow on the line is 500 MVA. RTCA indicates that if a single Contingency elsewhere in the system were to occur, flow on this line would immediately jump to 925 MVA. The worst single Contingency event actually occurs, and as expected, flow on this line immediately jumps to 925 MVA. The System Operator has 15 minutes to reduce flow on this line to an acceptable level. If flow is not reduced to an acceptable level within 15 minutes, facilities could be damaged, or worse, the line could sag creating a public safety hazard. After the Contingency event actually occurs, the system is in a new state. Real-time Assessments are now performed on the new system state. The Real-time Assessment against this new state now indicates that if a Contingency elsewhere in the system were to occur, flow on this line would immediately jump to 975 MVA. At this point further mitigations must be made to bring post-Contingency flows below 950 MVA. Reference Figure 5 below for a pictorial of this scenario.

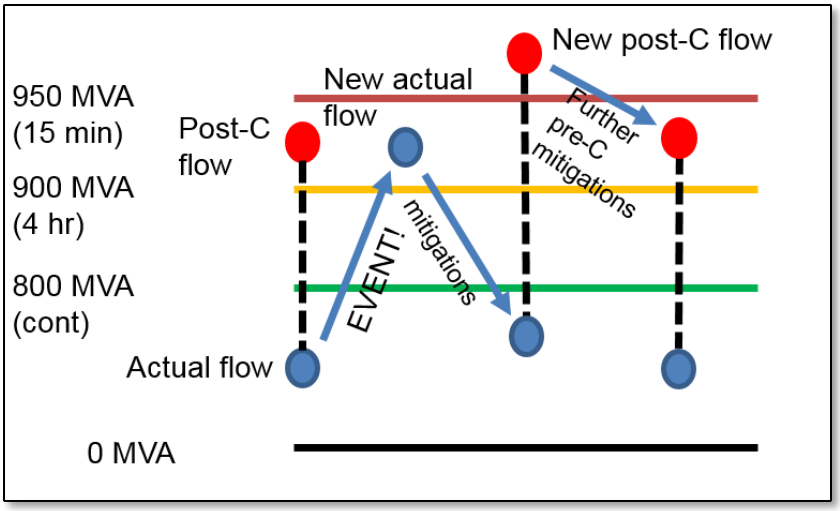

Figure 5. Example 4 Scenario – An Actual Contingency Event Occurs

<u>Steady State Voltage Limit Exceedance</u>

SOL performance for System Voltage Limits is determined through Operational Planning Analyses and through Real-time monitoring and Real-time Assessments. Normal and emergency System Voltage Limits are required to be established by the TOP in accordance with the RC's SOL methodology. FAC-011-4 Requirement R3 requires that the RC's SOL methodology contain specific requirements associated with the establishment of System Voltage Limits. Per FAC-011-4 Requirement R3, System Voltage Limits are required respect undervoltage load shedding relay settings and UVLS, to address coordination and common use of System Voltage Limits with neighbors, and to respect any equipment voltage limitations specified in the Transmission Owner's or the Generation Owner's Facility Ratings methodology per approved FAC-008-3.

Normal System Voltage Limits are typically applicable for the pre-Contingency state while emergency System Voltage Limits are normally applicable for the post-Contingency state. SOL exceedance with respect to these System Voltage Limits occurs when either actual bus voltage is outside acceptable pre-Contingency (normal) System Voltage Limits, or when Real-time Assessments indicate that bus voltages are expected to fall outside emergency System Voltage Limits in response to a Contingency event. System Voltage Limits are often established as normal and emergency high and low limits as depicted in the example in Figure 6. However, some TOPs might implement time-based System Voltage Limits as shown in the example in Figure 7. Any System Voltage Limit must be established in accordance with its RC's SOL methodology. Real-time Assessments should recognize the impact of automatically controlled reactive devices and whether or not those devices are sufficient without manual operator action for maintaining voltages within System Voltage Limits pre- or post-Contingency.

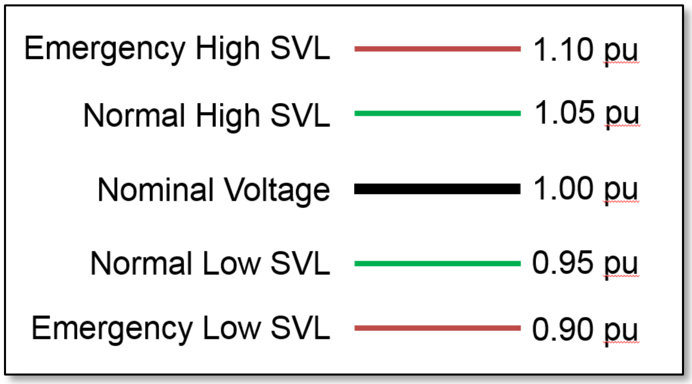

Figure 6. Example of a System Voltage Limit Set

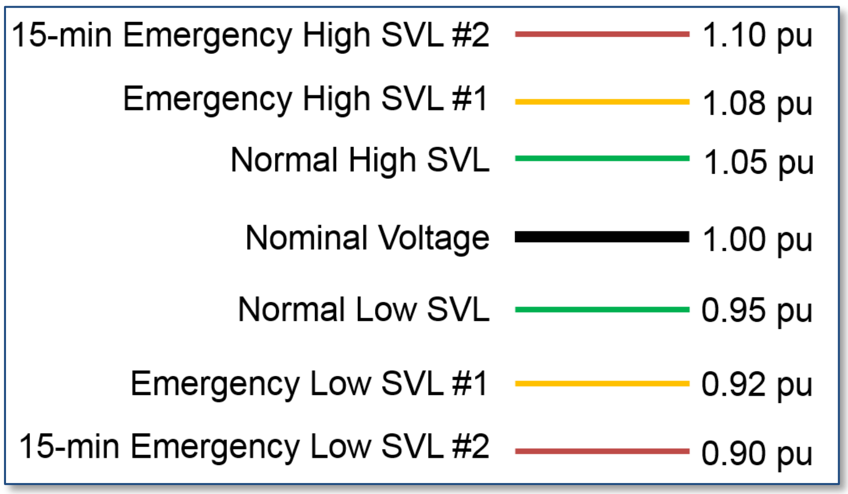

Figure 7. Example of a System Voltage Limit Set Utilizing Time-Based Values

<u>Stability Limit Exceedance</u>

Transient and voltage stability limits can be determined through prior studies, or they can be determined in Real-time.

Transient Stability limits are often expressed as flow limits on a defined interface or cut plane that, if operated within, ensures that the system will remain transiently stable should the identified limiting Contingency(s) occur. Transient instability could take several forms, including undamped oscillations, or angular instability resulting in portions of the system losing synchronism.

Though voltage Stability limits can be determined, expressed, and monitored in several ways, the general principle is universal – voltage Stability limits are intended to ensure that the system does not experience voltage collapse in the pre- or post-Contingency state.

SOL exceedance for stability limits occurs when the system enters into an operating state where the next Contingency could result in transient or voltage instability. Stability limits are defined to identify the point at which this would occur. Operating within defined stability limits prevents the associated Contingency (ies) from resulting in instability. Figure 8 depicts a wide-area's voltage Stability performance exceeds an SOL that qualifies as an IROL. In this example, the SOL (IROL) exceedance occurs when power transfers over the monitored Facility(s) exceeds the P_{IROL} value. Note - A localized voltage collapse may not qualify as an IROL.

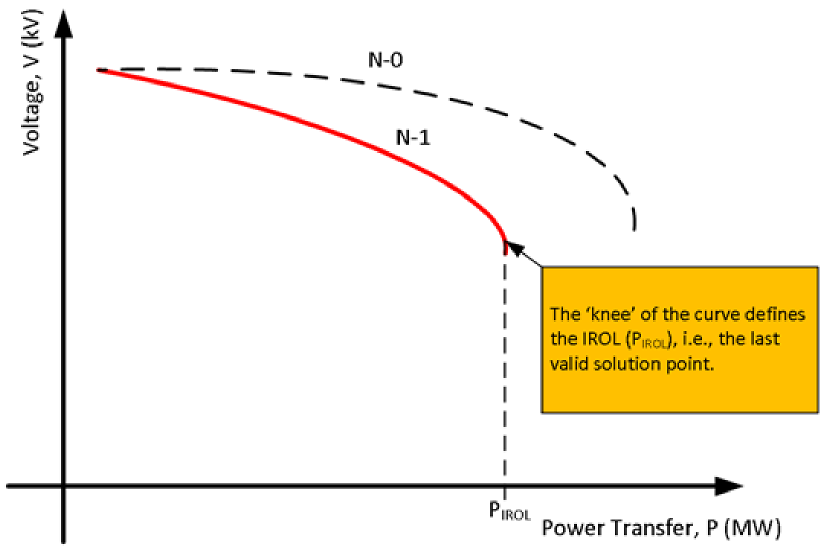

Figure 8. Voltage Stability System Operating Limit Performance Summary

SOL Exceedance and Operating Plans:

SOL exceedances occur when the performance framework described in proposed FAC-011-4 Requirement R6 is not being met; in Real-time operations, SOL exceedances are determined through Real-time monitoring and Real-time Assessments, while in the day-ahead space, potential SOL exceedances are determined through Operational Planning Analyses. For Facility Ratings and System Voltage Limits, SOL exceedances are identified through the evaluation of the pre-Contingency state and through an evaluation of Contingencies against that state. For stability limits, SOL exceedances are identified through system monitoring against defined stability limits or through the evaluation of stability performance against defined stability performance criteria.

When an SOL is being exceeded in Real-time operations, the Transmission Operator is required to implement mitigating strategies consistent with its Operating Plan(s). Operating Plans can include specific Operating Procedures or more general Operating Processes. Operating Plans include both pre- and post-Contingency mitigation plans/strategies. Pre-Contingency mitigation plans/strategies are actions that are implemented before the Contingency occurs to prevent the potential negative impacts on reliability of the Contingency. Post-Contingency mitigation plans/strategies are actions that are implemented after the Contingency occurs to bring the system back within limits. Operating Plans contain details to include appropriate timelines to escalate the level of mitigating plans/strategies to ensure acceptable BES performance is maintained, preventing SOL exceedances from escalating to a condition where the next Contingency could result in System instability, Cascading, or uncontrolled separation. Operating Plan(s) must include the appropriate time element to return the system to within acceptable Normal and Emergency (short-term) Ratings and/or SOLs identified above.

An example of a general Operating Plan is shown in Table 1.

Thermal SOL Limit Exceeded	Pre-Contingency (actual) Loading	Post-Contingency (calculated) Loading
Normal (24 hr)	Reconfiguration actions, Redispatch actions, emergency procedures except Load shed consistent with timelines identified in the specific Operating Plan.	Trend – continue to monitor. Take reconfiguration actions to prevent Contingency from exceeding emergency limit consistent with timelines identified in the specific Operating Plan.
Emergency (4 hr)	All of the above plus Load shed only if necessary and appropriate to control loading below 4 hr Emergency Rating consistent with timelines identified in the specific Operating Plan.	Use available effective actions and emergency procedures except Load shed consistent with timelines identified in the specific Operating Plan.
Emergency (15 min)	All of the above plus Load shed to control loading below 15 min Emergency Rating consistent with timelines identified in the specific Operating Plan.	Take action (reconfigure, redispatch, etc. per the specific Operating Plan) to address the unacceptable post-Contingency condition. Load shed only if necessary and appropriate to avoid post-Contingency Cascading consistent with timelines identified in the specific Operating Plan.

Table 1. Operating Plan Example

APPLICABLE DEFINITIONS

Real-time Assessment – An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions. The assessment shall reflect applicable inputs including, but not limited to: load, generation output levels, known Protection System and Special Protection System status or degradation, Transmission outages, generator outages, Interchange, Facility Ratings, and identified phase angle and equipment limitations. (Real-time Assessment may be provided through internal systems or through third-party services.)

Operational Planning Analysis – An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect applicable inputs including, but not limited to: load forecasts, generation output levels, Interchange, known Protection System and Special Protection System status or degradation, Transmission outages, generator outages, Facility Ratings, and identified phase angle and equipment limitations. (Operational Planning Analysis may be provided through internal systems or through third-party services.)

Changes made to the definitions of Real-time Assessment and Operational Planning Analysis were made in order to respond to issues raised in NOPR paragraphs 55, 73, and 74 dealing with analysis of SOLs in all time horizons, questions on Protection Systems and Special Protection Systems in NOPR paragraph 78, and recommendations on phase angles from the SW Outage Report (recommendation 27). The intent of such changes is to ensure that Real-time Assessments and Operational Planning Analysis contain sufficient details to result in an appropriate level of situational awareness. Some examples include: 1) analyzing phase angles which may result in the implementation of an Operating Plan to adjust generation or curtail transactions so that a Transmission facility may be returned to service, or 2) evaluating the impact of a modified Contingency resulting from the status change of a Special Protection Scheme from enabled/in-service to disabled/out-of-service.

Operating Plan – A document that identifies a group of activities that may be used to achieve some goal. An Operating Plan may contain Operating Procedures and Operating Processes. A company-specific system restoration plan that includes an Operating Procedure for black-starting units, Operating Processes for communicating restoration progress with other entities, etc., is an example of an Operating Plan.

Operating Process – A document that identifies general steps for achieving a generic operating goal. An Operating Process includes steps with options that may be selected depending upon Real-time conditions. A guideline for controlling high voltage is an example of an Operating Process.

Operating Procedure – A document that identifies specific steps or tasks that should be taken by one or more specific operating positions to achieve specific operating goal(s). The steps in an Operating Procedure should be followed in the order in which they are presented, and should be performed by the position(s) identified. A document that lists the specific steps for a System Operator to take in removing a specific transmission line from service is an example of an Operating Procedure.

Time Horizons

When establishing a time horizon for each requirement, the following criteria should be used:

- **Long-term Planning** – a planning horizon of one year or longer.
- **Operations Planning** – operating and resource plans from day-ahead, up to and including seasonal.
- **Same-Day Operations** – routine actions required within the timeframe of a day, but not Real-time.
- **Real-time Operations** – actions required within one hour or less to preserve the reliability of the Bulk Electric System.

Facility Rating – The maximum or minimum voltage, current, frequency, or real or reactive power flow through a facility that does not violate the applicable equipment rating of any equipment comprising the facility.

Normal Rating – The rating as defined by the equipment owner that specifies the level of electrical loading, usually expressed in megawatts (MW) or other appropriate units that a system, facility, or element can support or withstand through the daily demand cycles without loss of equipment life.

Emergency Rating – The rating as defined by the equipment owner that specifics the level of electrical loading or output, usually expressed in megawatts (MW) or Mvar, or other appropriate units, that a system, facility, or element can support, procedure, or withstand for a finite period. The rating assumes acceptable loss of equipment life or other physical or safety limitations for the equipment involved.